
Contents

Abstract	III
Acknowledgements	V
Preface	VII
<hr/>	
Part I Introduction and Definitions	
<hr/>	
4 Introduction	3
5 Preliminaries	7
5.1 Mathematical Background	7
5.1.1 Sets	7
5.1.2 Relations	9
5.1.3 Functions	10
5.1.4 Graphs	10
5.2 Basics of Formal Language Theory	11
5.2.1 Strings and Languages	11
5.2.2 Language Families	14
5.2.3 Grammars	15
5.2.4 Derivation Trees	21
5.2.5 Automata	22
6 Regulated Grammars	25
6.1 Regular-Controlled Grammars	25
6.2 Matrix Grammars	29
6.3 Programmed Grammars	31
6.4 Random Context Grammars	33
6.5 Scattered Context Grammars	36
6.6 State Grammars	40

Part II Transformations of Regulated Grammars

7	Normal Forms	45
	7.1 Scattered Context Grammars	45
	7.2 Programmed Grammars	48
8	Elimination of Erasing Rules	55
	8.1 Context-Free Grammars	55
	8.1.1 Standard Algorithm	56
	8.1.2 New Algorithm	58
	8.1.3 Applicability to Regulated Grammars	63
	8.2 Workspace Theorems for Regular-Controlled Grammars	64
	8.3 Generalized Restricted Erasing in Scattered Context Grammars	79
9	Generation of Extended Languages	97
	9.1 Regular-Controlled Generators	98
	9.2 Coincidental Extension of Scattered Context Languages	112
10	Conversions Between Regulated Grammars and Their Equivalents	115
	10.1 Reduction of Scattered Context Grammars	116
	10.2 One-sided Random Context Grammars	137
	10.3 Deep Pushdown Automata	152

Part III Transformations of Related Regulated Formal Systems

11	Transformations of Regulated Grammar Systems	167
	11.1 Multigenerative Grammar Systems	168
	11.2 Leftmost Multigenerative Grammar Systems	183
12	Transformations of Regulated Automata	197
	12.1 Regulated Pushdown Automata	198
	12.2 One-Turn Atomic Regulated Pushdown Automata	208

Part IV Concluding Remarks

13	Theoretical Remarks	215
	13.1 Open Problems	215
	13.2 New Trends	216
	13.3 Bibliographical Remarks	217
14	Remarks on Applications	219

Bibliography 223

Language Family Index 231

Subject Index 233

Introduction and Definitions